

## **TITLE**

### **Grounding System for Floating Roofs in Flammable Storage Tanks**

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## **FIELD OF THE INVENTION**

The present invention relates to a low impedance grounding system for grounding tank roofs and reducing the bound charge in floating roof tanks.

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## **BACKGROUND OF THE INVENTION**

The roof of many large crude storage tanks is open in the sense that there is no permanently attached roof. The roof floats on top of the product. To prevent vapors from escaping from around the edge of the roof, it is common to provide some sort of seal. These seals are made of a non-conductive material, usually neoprene. This material isolates the roof from the tank wall electrically and from any connection to earth. To overcome this problem, the industry has installed a device called a "shunt." These shunts are attached to the roof in such a manner that they are to be in constant contact with the tank regardless of the position of the floating roof. To make contact, these shunts are made with metal fingers which are spring-loaded and are made springy by the material used. These shunts require constant maintenance for several reasons:

1. Since the roof floats, it can easily drift slightly off-center and disconnect from the shunt on the opposite side.

2. Wax and other heavy crude elements tend to deposit  
5 between the tank wall and the shunt fingers, leaving a small gap which can cause arcing and fire.

Such a fire is called a "rim fire". In this case, the arc ignites the gasses always prevalent around the rim just above the seal.

10 During an electrical storm, the electrostatic field will induce a charge on both the tank and the contained product. Lightning dissipaters will discharge both the tank and the product for most situations. However, if the tank has a large diameter, the storm cell contains an unusually  
15 large charge, the product near the center will not be completely discharged. If the shunts are not in perfect contact with the tank wall, the "bound charge" will create an arc when that storm cell is discharged by a nearby strike. Refer to the American Petroleum Institute (API)  
20 Recommended Practices RP2003 for details on the Bound Charge/Secondary Arc. Some companies have tried to use long wires that extend from the top of the tank down to the center of the floating roof. The problem with this technique is that the impedance of the wire is far too high  
25 to react within the time available to discharge a bound charge (about one microsecond). The average impedance of these connections is between 150 and 250 Ohms at lightning frequencies.

Eliminating the risk of a bound charge arcing requires making a full-time positive connection between the tank wall and roof of the tank, as well as having a low impedance path of about one Ohm or less. Making a positive connection will  
5 eliminate this risk and any other phenomena that can create a body of bound charge. The present invention discloses a grounding system that will satisfy the above requirements in one complete assembly. The copper braid has an impedance of about one Ohm.

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#### SUMMARY OF THE INVENTION

The main aspect of the present invention is to provide a cable having low impedance, the cable being electrically connected to a floating roof and the wall of the tank that  
15 the floating roof floats in.

Another aspect of the present invention is to provide a take up reel to keep the slack out of the cable, and minimize the impedance.

Other aspects of this invention will appear from the  
20 following description and appended claims, reference being made to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

A reel is mounted at the top of the inside of a  
25 fluid/liquid storage tank. The grounding cable unreels from the reel as the floating roof is lowered down into the tank as the stored fluid/liquid level lowers. As the floating roof rises a take up assembly in the reel takes up the

slack, preferably by maintaining a constant pressure on the grounding cable. Electric charge in the stored fluid/liquid is collected through the floating roof, conducted through the grounding cable, and the reel, to the tank wall and  
5 thence to the earth ground.

The reel assembly guide is constructed from 316 stainless steel, with provisions for mounting on the top edge of the tank: one model for edge mounting, and the other for mounting on the top angle. The flat copper conductor  
10 end is attached to a roof structure, using several possible options. Since floating roof tanks tend to have large diameters, they can accumulate a very large body of charge in the center of the tank. That charge must be carried to the closest location of the tank wall. To assure that path  
15 is not too long, more than one grounding system may be required. To provide an estimate of the number of these grounding systems, the following criteria is suggested:

Tank Diameter (Meters) versus # of Grounding Systems Recommended

20	Up to 30	1
	Up to 50	2
	Up to 60	3
	Up to 70	4
	Up to 80	5
25	Up to 90	6
	Up to 100	8

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a reel.

FIG. 2 is a top perspective view of a fluid/liquid storage  
5 tank.

FIG. 2A is a partial cutaway perspective view of a  
fluid/liquid storage tank with the preferred embodiment  
roof grounding system installed.

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FIG. 3 is a vertical sectional view of the tank shown in  
FIG. 2.

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FIG. 4 is a plan view of the preferred embodiment as seen  
from inside the tank shown in FIG. 2.

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Before explaining the disclosed embodiment of the  
present invention in detail, it is to be understood that the  
invention is not limited in its application to the details  
of the particular arrangement shown, since the invention is  
capable of other embodiments. Also, the terminology used  
herein is for the purpose of description and not of  
limitation.

## Detailed Description of Drawings

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Referring first to FIG. 1 a reel 1 has a base 4 which  
is preferably bolted onto the top of the tank as seen in  
FIG. 3. The spool 5 of the reel 1 receives a 480/30 flat

braided copper wire 2 or any wire which offers a very low impedance to a lightning strike. A housing 3 covers a coil spring 31 which constantly pulls on the wire 2 to keep out the slack.

5 Referring next to FIG. 2 the reel 1 can be seen bolted to the top of the cylindrical wall 21 of tank 20. A floating roof 23 floats on the fluid/liquid 22. The wire 2 is connected to the floating roof 23, directly below the reel.

10 Referring next to FIGS. 3,4 the reel 1 has bolts 31 connecting the base 4 of the reel 1 to the tank wall 21. The fluid/liquid 22 which may be oil floats the floating roof 23. As the floating roof 23 moves up and down it is centered in the tank 21 by a known scissor assembly 33. A  
15 known fumes barrier 34 rides along the inside of the tank 21 as does the scissor assembly 33. A known grounding shunt 35 also rides along the inside of the tank 21, but can lose its grounding connection as debris builds up on the inside of the tank.

20 The bolt and nut assembly 7 secures the lug 6 to the outer wall 230 of the floating roof 23. The spring 39 keeps the slack out of wire 2 so as to prevent entanglement with the shunt 35 and/or the scissor assembly 33. The path to ground is shown by arrows G. The impedance of the lug bolt

and braided copper cable is about one ohm or less. The impedance of the whole system is about five ohms or less.

Although the present invention has been described with reference to preferred embodiments, numerous modifications  
5 and variations can be made and still the result will come within the scope of the invention. No limitation with respect to the specific embodiments disclosed herein is intended or should be inferred.